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Contrasting responses of phosphatase kinetic parameters to nitrogen and phosphorus additions in forest soils

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Abstract

© 2017 The Authors. Functional Ecology © 2017 British Ecological Society Global changes include increasing nitrogen (N) and phosphorus (P) deposition, which affect microbial nutrient demand and biogeochemical cycles. The responses of P-mineralizing enzymes to these global change components are poorly defined and are not specified in forest soils differing in P content. We chose one site in a P-rich and two sites in P-poor forests and established sixteen 20 × 20 m plots at each site. Control, either N only, P only, or combined N and P, were randomly distributed through each forest site with four replicates. We investigated the effects of N and P additions over 4 years on the phosphomonoesterase potential activity (Vmax), its half-saturation constant (Km) and its catalytic efficiency (Vmax/Km). Without N and P additions, the enzyme kinetic parameters Vmax, Km and Vmax/Km were higher in P-rich than in P-poor forest soils. These parameters increased with soil pH, SOC, TN and TP contents increased. Remarkably, P additions caused the Vmax and Km to increase in P-rich soils, but had no effect on Vmax/Km. P additions to P-poor soils resulted in a decrease in the Vmax/Km via the inhibitory effects of inorganic P on the Vmax. N additions had no effect on the Vmax/Km in P-rich and P-poor soils because of the similar increases in the Vmax and Km. The effects of combined N and P and P only additions to P-poor soils on the Vmax and Km were similar, but were stronger than the effects of N only or P only additions on the P-rich soils. Phosphatase kinetic parameters were positively related to the availability of N and P in P-rich soils, but inorganic P inhibited phosphatase activity and caused a decrease in the catalytic efficiency in P-poor soils. More microbial community groups could contribute to the secretion of a broader spectrum of iso-enzymes under combined additions of N and P in P-rich soils. We conclude contrast responses of phosphatase kinetics to P and N inputs in P-rich and P-poor forest soils, while long-term N deposition might mitigate P limitation by increasing phosphatase secretion. A plain language summary is available for this article.

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Keywords

catalytic efficiency, kinetic parameters, nitrogen, phosphatase, phosphorus, subtropical forest, temperate forest

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